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The invention relates to a rotating condenser with a condenser block, which exhibits liquefaction passages for an heating medium and at least one rotating section with evaporation passages for a liquid, whereby the entry port and the outlet of each evaporation passage on opposite sides of the condenser block are and whereby the entry ports of all evaporation passages of the rotating section are underneath the outlets of the evaporation passages of the rotating section disposed.

With a very low-temperature liquid air separation plant with a Drucksäule and a low pressure column liquid oxygen becomes from the low pressure column vaporized against gaseous nitrogen from the Drucksäule in the indirect heat exchange in an heat exchanger, whereby the nitrogen condensed. A such condenser evaporator system becomes usually referred as main capacitor.

The main capacitor becomes almost exclusively as plate heat exchangers made and formed as dropfilm-evaporated or as rotating condenser. With a rotating condenser the condenser block stands for liquid in the liquid bath, from the vaporized will is. The liquid occurs from downside the evaporation passages of the condenser block and partly becomes against the heating medium vaporized flowing by the liquefaction passages. The density of the Mediums evaporating in the evaporation passages is smaller than the density of the surrounding liquid bath, whereby a siphon effect develops, so that liquid from the liquid bath flows into the evaporation passages.

In the main capacitor of a liquid air separation plant liquid oxygen becomes vaporized. Here it is to be made certain that the liquid oxygen inflowing into the evaporation passages of the condenser block becomes only a fraction vaporized. By the fact prevented becomes that become possibly enriched in the liquid oxygen present disturbing contaminants. Thus for example only about 10% of the amount at liquid oxygen, inflowing into the evaporation passages, become vaporized and 90% as liquid of the outlets of the evaporation passages back the entry ports of the evaporation passages promoted. The part of the condenser block, becomes achieved in which such a circulation of liquid, becomes in the following referred as rotating section.

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The per large submergence of the condenser block of a rotating condenser in the liquid bath, becomes the higher the medium hydrostatic pressure in the evaporation passages and the poor is the vaporized liquid, since the boiling temperature of the liquid the corresponding vapour pressure diagram rises. The efficiency of a rotating condenser can become however by subdivision of the condenser block into several disposed rotating sections elevated one above the other. The advantage of a such arrangement lies in the fact that the submergence of the single rotating sections is smaller in each case than with a single high condenser block. Thus the hydrostatic pressure in the evaporation passages becomes smaller and the liquid can easy evaporated.

From the DE 199 39 294 a mehrstöckiger rotating condenser is known, with which the entry ports and the outlets of the evaporation passages of a rotating section on opposite sides of the heat exchanger block are. In this way achieved one flow paths for the liquid oxygen, which can be evaporated of equal length in all evaporation passages. This has the advantage that the pressure losses and thus the rotating rates are in all evaporation passages same. On the other hand this arrangement has however the disadvantage the fact that the circumferential liquid amount of oxygen always withdraws on that the entry ports of opposite side of the condenser block and over constructive aufwändige pipings or channels the entry ports returned must become.

Object of the instant invention is to be developed it therefore, a rotating condenser, with which in all evaporation passages as uniform a vaporization of the liquid as possible achieved will and to which with if possible small constructive effort can be manufactured.

This object becomes by a rotating condenser that initially mentioned type dissolved, with which first and second evaporation passages provided are and itself the entry ports of the first evaporation passages and the outlets of the second evaporation passages on the same side of the condenser block find.

The liquid according to invention occurs vaporized from downside the first evaporation passages, flows in the evaporation

passages upward, partly and leaves the first evaporation passages on the opposite side of the condenser block. The liquid portion from the first evaporation passages outgoing liquid gas mixture flows to the entry ports of the second evaporation passages disposed on the same side as the outlets of the first evaporation passages. The liquid flows then by the second evaporation passages back to the side of the condenser block, on which the entry ports are into the first evaporation passages. During flowing through the second evaporation passages again a part of the liquid becomes vaporized.

The liquid becomes according to invention by means of the first and second evaporation passages between two opposite sides of the condenser block back and forth promoted and increasing vaporized. Expensive constructions such as reconducting pipes or return ducts for the liquid are not any longer required therefore.

The evaporation passages are so performed with the fact that all entry ports of a rotating section are underneath the outlets of this rotating section. In this way such a liquid level can become chosen before the entry ports that the liquid occurs over the entry ports all evaporation passages, which end to outlets however in the gas space. This has the advantage that the liquid gas mixture in all evaporation passages, ascending in the evaporation passages, experiences the same backpressure, whereby again different rotating rates in the single evaporation passages become avoided.

Becomes besides the liquid level before the entry ports a so high chosen that the static pressure at the single entry ports differs around less as 20%, prefered less as 10%, particularly prefered less than 5%, then almost same rotating rates become achieved by all evaporation passages.

Preferably all first and/or all second evaporation passages of a rotating section are same in each case prolonged. Particularly prefered possesses all evaporation passages of a rotating section the equal length. In this way the rotating rate is in all evaporation passages same, D. h. in each evaporation passage the same ratio from not vaporized liquid to vaporized amount of gas adjusts itself. Thus the liquid which can be evaporated will not enrich always good mixed and eventual contaminants itself in the liquid on.

In a preferable embodiment a rotating section exhibits exactly the same many first like second evaporation passages. Besides it is favourable, if all evaporation passages possess the same cross section. By this measure ensured becomes that exactly the same much liquid becomes promoted by the first evaporation passages as by the second evaporation passages.

The rotating condenser according to invention is suitable in particular as main capacitor of a very low-temperature liquid air separation plant.

The invention as well as other details of the invention become in the following more near explained on the basis the represented embodiments schematic in the designs. Here show:

Fig. 1 the evaporation passages of a rotating section according to invention,

▲ top Fig. 2 the view A von Fig. 1,

Fig. 3 the view A of an alternative embodiment of Fig. 1,

Fig. 4 a rotating condenser with four one above the other disposed rotating sections,

Fig. 5 the plan view on Fig. 4,

Fig. 6 a condenser evaporated system with four parallel disposed condenser blocks, which consist in each case of four one above the other disposed rotating sections,

Fig. 7 a section along line A-A in Fig. 6,

Fig. 8 the plan view on the condenser blocks in accordance with Fig. 6,

Fig. 9 a section along line A-A in Fig. 6 with an alternative arrangement of the evaporation passages and

Fig. 10 the plan view on the arrangement of the evaporation passages in accordance with Fig. 9.

In Fig. 1 is a schematic rotating section of a rotating condenser shown, which becomes used as main capacitor of a double column in a very low-temperature liquid air separation plant the evaporated one of oxygen. The rotating condenser possesses a variety of parallel disposed heat exchange passages, becomes condensed in which gaseous nitrogen in the indirect heat exchange with liquid oxygen, whereby the oxygen vaporized.

In Fig. 1 not represented liquefaction passages for the nitrogen extend from above downward over the full height of the

rotating condenser. To the guide of the oxygen two various types of evaporation passages are 1, 11 provided. In the drawing the limitations of the first evaporation passages 1 with solid lines are, those of the second evaporation passages 11 with dotted lines shown.

In the representation in accordance with Fig. the first evaporation passages 1 possess 1 to the left bottom end of the rotating section their entry ports 2 and at the right upper end their outlets 3. The second evaporation passages 11 run opposite from right down to the left above. The single evaporation passages 1, 11 run on the basis of the respective entry port 2, 12 first horizontal, then vertical upward and finally horizontal to the outlets 3, 13. By this embodiment achieved becomes that all evaporation passages possess the same length in each case.

Fig. the view shows 2 in Fig. 1 side of the rotating section referred with "A". The liquefaction passages 4 for the nitrogen and the evaporation passages 1, 11 for the oxygen alternate, in order to obtain as good an heat exchange between the nitrogen and the oxygen as possible. The first evaporation passages 1 are in half of the rotating section, the second evaporation passages 11 in the other half.

Corresponding ones are in the right half of the Fig. 2 the entry ports 2 of the first evaporation passages 1 and in the left half of the Fig. to recognize 2 the outlets 13 of the second evaporation passages 11.

In Fig. 3 is an alternative arrangement of the evaporation passages 1, 11 shown. The evaporation passages 1, 11 alternate again with the liquefaction passages 4. In contrast to the arrangement in accordance with Fig. 2 is now in addition, the first evaporation passages 1 and the second evaporation passages 11 alternate disposed, whereby between a first evaporation passage 1 and a second evaporation passage 11 a liquefaction passage 4 is in each case. In other words: In the representation in accordance with Fig. the 1 repeated itself passage arrangement multiple subsequent vertical in a direction to the sheet-planar: a plane with nitrogen passages 4, followed of of on the left of down to the right longitudinal above first evaporation passages 1, followed of an other plane with nitrogen passages, which finally from on the right of down longitudinal above second evaporation passages 11 follow to the left.

Fig. 4 shows a section by a rotating condenser according to invention, which becomes used as main capacitor of a double column of a very low-temperature liquid air separation plant. The rotating condenser consists of four one above the other disposed rotating sections 100, 200, 300, 400. To with in and outlets, z. B. 402, 403, 412, 413, provided sides of each rotating section 100, 200, 300, 400 are in each case liquid tank 120, 220, 320, 420 mounted.

On a side of the condenser block the liquid tanks are 120, 220, 320, 420 21 connected with one another by means of an overflow pipe. The overflow pipe 21 possesses an entry port 122, 222, 322, 422 on the height of each rotating section 100, 200, 300, 400, so that with a certain level the respective liquid tank liquid occurs 120, 220, 320, 420 the overflow pipe 21 and becomes the liquid tank 120, 220, 320 of the rotating section 100, 200, 300 passed located under it.

The entry ports 122, 222, 322, 422 into the overflow pipe 21 are provided that in the operation the maximum level lies in the liquid tanks 120, on such an height, 220, 320, 420 between 50 and 90%, preferably between 60 and 80% of the height of the respective rotating section 100, 200, 300, 400. Particularly prefered is the entry ports 122, 222, 322, 422 top into the overflow pipe 21 so mounted that the maximum liquid level is in the liquid tanks 120, 220, 320, 420 underneath the outlets 3, 13.

By the inventive arrangement of all entry ports 2, 12 underneath the outlets 3, 13 of the respective rotating section a liquid level in the liquid tanks 120, 220, 320, 420 chosen can become, which lies between the highest entry port 2, 12 and the lowest outlet 3, 13. Thus ensured becomes that all evaporation passages 1, 11 at its entry 2, 12 in liquid and because of its exit 3, 13 in the gas space to be. The backpressure at outlet end the 3, 13 is same, so that in all evaporation passages 1, therefore with all evaporation passages 1, 11, 11 an approximate same rotating rate achieved becomes.

The liquid tanks 120, 220, 320, 420 become besides 23 penetrated, so that the 11 and into the liquid tanks 120, 220, 320, 420 flowing oxygen gas resultant with the vaporization in the evaporation passages 1, of two gas collecting lines, from the liquid tanks 120, 220, 320, 420 23 withdrawn over the gas collecting line can become.

In Fig. 5 is the arrangement of the gas collecting lines 23 and the overflow pipe 22 in the plan view shown. The first and second evaporation passages 1, 11 are in each rotating section 100, 200, 300, 400 like above on the basis Fig. 2 explained, disposed. In the representation in accordance with Fig. 5 is the first evaporation passages 1 in the bottom half of the drawing, the second evaporation passages 11 in the upper design half. Corresponding one becomes by the first evaporation passages 1 liquid from on the left of to the right and by the second evaporation passages 11 of on the right of to the left transported.

The gas collecting lines 23 are so disposed that they are not straight before the outlets of the evaporation passages 1, 11. By the lateral displacement of the gas collecting lines 23 opposite the outlets 3, 13 of the evaporation passages 1, 11 becomes the 11 gas liquid mixture first diverted outgoing from the evaporation passages 1, whereby the flow velocity of the gaseous oxygen becomes lowered and gaseous separated of liquid oxygen. Dragging along of liquid oxygen into the gas collecting line 23 becomes to a large extent avoided.

The entire liquid becomes optimum mixed in a rotating section 100, 200, 300, 400 always of a side on the other side of

the rotating section 100, 200, 300, 400 and again back promoted and. It is therefore only on a side of the condenser block a liquid overflow 21 necessary. This overflow 21 becomes preferably on the side of the condenser block disposed, at that above the supply 25 of the liquid oxygen made.

The not represented nitrogen passages extend over the full height of the condenser block, i.e. over all rotating sections 100, 200, 300, 400. The gaseous nitrogen becomes over the feed line 26 the nitrogen passages supplied and 27 withdrawn as liquid at the lower end the block over conduit. The distribution of the gaseous nitrogen on the nitrogen passages made over a collecting tank/a manifold 28 connected with the condenser block.

Into the Fig. 6 to 8 is an other variant of the rotating condenser according to invention shown. This consists those of four condenser blocks 61, 62, 63, 64, again in each case of four rotating sections 100, 200, 300, 400 exhibits. Ever two condenser blocks 61, 62 and/or. 63, 64 is direct next to each other disposed, so that the respective evaporation passages 1, 11 parallel run to each other. The so resultant double blocks 61, 62 and/or. 63, 64 stands themselves with their in and/or. Outlets 2, 3, 12, 13 opposite (see Fig. 8). The arrangement of the first and second evaporation passages 1, 11 corresponds again to Fig. 2. The condenser blocks 61 and 62 and/or. 63 and 64 becomes so next to each other disposed that of them together-border with the first evaporation passages 1 provided block halves.

The two double blocks 61, 62 and/or. 63, 64 possesses in each case a common liquid tank 20. In the middle between the condenser blocks 61, 62, 63, 64 is each rotating section of 200, 300, 400 all blocks common liquid tanks 30. The outside liquid tanks 20 collect only the circumferential liquid, those by the second evaporation passages 11 into the liquid tanks 20 passed and will promote them by means of the first evaporation passages 1 again back to the central liquid tank 30.

Due to the described arrangement of the evaporation passages 1, 11 the made supply of the gas of liquid mixture essentially in the middle of the liquid tank 30, outgoing from the first evaporation passages 1. The gas collecting lines 23 become therefore in the outer region of the liquid tank 30 in the vicinity of the entry ports into the second evaporation passages 11 disposed. In these zones the flow velocity from the first evaporation passages so far calmed 1 outgoing gas liquid mixture down that practical no liquid is drug along into the gas collecting lines 23.

Into the Fig. 9 and 10 is an alternative arrangement of the evaporation passages 1, 11 with an arrangement of the condenser blocks 61, 62, 63, 64 in accordance with Fig. 6 shown. Just like with the system in accordance with the Fig. here a rotating section consists 6 to 8 of the respective portions 100, 200, 300, 400 of the four condenser blocks 61, 62, 63, 64. In this case however each of the blocks does not possess 61, 62, 63, 64 first evaporation passages 1 and second evaporation passages 11.

The current according to invention by first evaporation passages 1 and backflow by second evaporation passages 11 becomes not 64 realized, but thus in each single block 61, 62, 63, that the two adjacent condenser blocks 61, 62 and/or. 63, 64, in each case around 180 DEG rotated, assembled become. The evaporation passages of the condenser block 61 and/or. 63 corresponds thereby to the second evaporation passages 11 and the evaporation passages in the condenser blocks 62 and/or. 64 corresponds to the first evaporation passages 1.

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1. Rotating condenser with a condenser block, which liquefaction passages for an heating medium and at least one rotating section with evaporation passages for a liquid exhibits, whereby the entry port and the outlet of each evaporation passage on opposite sides of the condenser block are and whereby the entry ports of all evaporation passages of the rotating section are underneath the outlets of the evaporation passages of the rotating section disposed, characterised in that first and second evaporation passages (1, 11) provided are and itself the entry ports (2) of the first evaporation passages (1) and the outlets (13) of the second evaporation passages (11) on the same side of the condenser block find.

2. Rotating condenser according to claim 1, characterised in that all first evaporation passages (1) and/or all second evaporation passages (11) same prolonged are.

3. Rotating condenser after one of the claims 1 or 2, characterised in that the rotating section (100, 200, 300, 400) exactly the same many first like second evaporation passages (1, 11) exhibits.

4. Rotating condenser after one of the claims 1 to 3, characterised in that all first and/or all second evaporation passages (1, 11) the same cross section possess.

5. Rotating condenser after one of the claims 1 to 4, characterised in that between two first evaporation passages (1) no second evaporation passage (11) disposed is.

6. Rotating condenser after one of the claims 1 to 5, characterised in that between two first evaporation passages (1) a precise second evaporation passage (11) disposed is.

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7. Use of a rotating condenser after one of the claims 1 to 6 as main capacitor of a very low-temperature liquid air separation plant.